

Sudbury Neutrino Observatory High Energy Event Analyses

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Although the primary goal of the Sudbury Neutrino Observatory (SNO) is the measurement of neutrinos from the Sun, there will be a sizable number of high energy events from muons and neutrinos produced in the atmosphere. Other experiments have used the signal from atmospheric neutrinos to claim evidence for neutrino oscillations. SNO may be able to do the same, however this will depend on the rate of events in the detector, and our ability to model the signal and detector response.

A plot of the angular distribution for a sample of high energy events seen in SNO is displayed in Figure 1. The solid curve above $\cos\theta \sim 0.5$ shows the predicted muon rates based on parameterizations of the fluxes of muons at the surface of the earth and the propagation of muons through the local rock. The agreement between the measured muons and this prediction is quite good, and demonstrates that we have good models for the muon flux, the propagation of those muons through the rock above the detector, and for the detector itself.

The downward-going muons vanish at an angle of $\sim 30^\circ$ above the horizon ($\cos\theta = 0.5$). Beyond this the signal is dominated by muons which were produced by the interactions of atmospheric neutrinos in the rock surrounding the detector. The zenith angle region at $0.0 < \cos\theta < 0.5$ will be quite important for the analysis of the neutrino-induced muon signal in terms of neutrino oscillations. At present, the uncertainty on the overall normalization of calculated atmospheric neutrino fluxes is 20% so that experiments which compare their total event rate to that expected based on those calculations must fold this uncertainty into their evaluation since they cannot tell if the flux is lowered because of oscillations, or an incorrect normalization. SNO will be able to remove this uncertainty by providing its own normalization based on the measured signal in the region above the horizon, which is not expected to be sensitive to the neutrino oscillations.

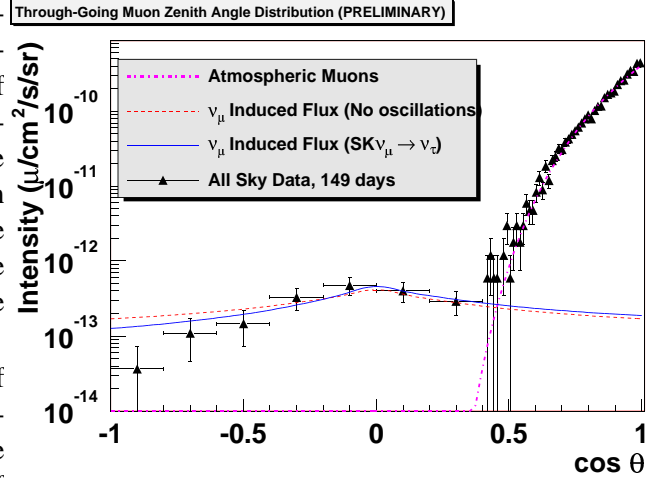


Figure 1: Zenith angle distribution for muons observed in the SNO detector. Values of $\cos\theta \sim 1$ are coming from above.

Because of the small size of the detector, the rate of neutrino-induced muons in the detector is approximately one every three days. Thus around three live years of data will be required to reach a statistical uncertainty which is smaller than the 20% theoretical uncertainty.